The clay pot cooler – an appropriate cooling technology

Information on construction and usage

Figure 1: Two vendors of vegetables with a clay pot cooler at the market in Ouahigouya, Burkina Faso.

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Introduction

The clay pot cooler is a simple and cheap way to keep food fresh (notably vegetables and fruits). The cooling function is based on the principle of evaporative cooling and is working best in hot and dry climates. These conditions are common in sub-Saharan Africa, where big parts of the population have no access to conventional, electrical refrigerators to keep their food fresh. In hot and dry climates (like northern Burkina Faso), with daily maximum air temperatures of 30 to 45°C this system of evaporative cooling enables to reach temperatures between 13 and 22°C inside the cooler. The clay pot cooler can extend the shelf life of food by three to four times. The objective of this document is to provide detailed information about the construction and utilization of the clay pot cooler as well as to highlight potential problems in order to support the dissemination of this appropriate technology. (The Information about temperatures or the mixture of materials for the production of clay pots are based on the experience of Peter Rinker (Movement e.V) in the very hot and dry northern part of Burkina Faso. Depending on regional differences in climate, availability of materials and pottery customs these information can deviate in different geographic contexts.)

Figure 2: Fresh vegetables stored in a clay pot cooler.

Functionality

The basic principle for the functioning of the clay pot cooler is the principle of evaporative cooling. The evaporation of water requires energy which is taken from the ambient air leading to a fall in air temperature.

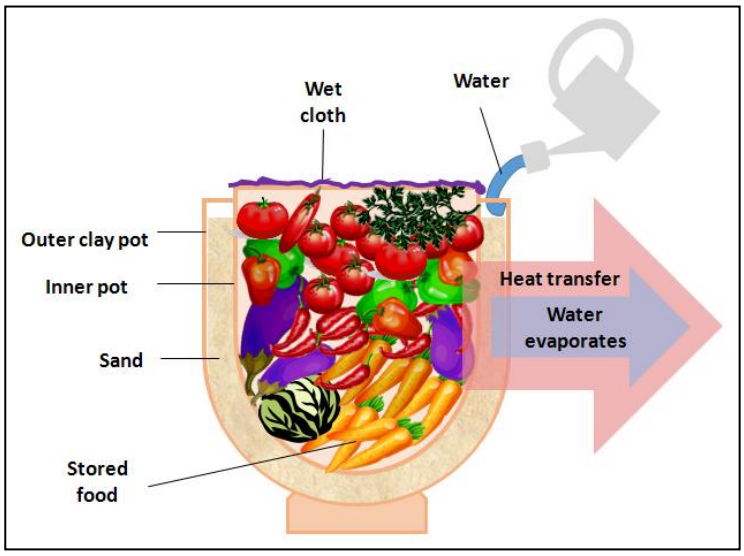

Figure 3: Clay pot cooler cooling system.

The clay pot cooler uses this principle with a relative simple construction made of two differently sized clay pots, wet sand and a cloth (see fig. 3). The smaller clay pot is placed in a bigger clay pot and the space between them is filled with coarse sand. This sand is watered and subsequently the opening of the small clay pot should be covered with a wet cloth. Due to the porosity of fired clay, a part of the water can diffuse through the clay end evaporate on the outside. This evaporation process consumes thermal energy from inside of the clay pot cooler resulting in a decreasing air temperature in the inner clay pot.

Positive impacts of the clay pot cooler

The use of clay pot coolers can have a wide range of positive impacts on producers and users of this appropriate technology:

- Rise of food security through enhanced lifetime of food and mitigation of food losses.
- Opportunity of storing food: users save money because of mitigated food losses and time because of less frequent purchases of food.
- Creation of work for local pottery making women, who produce the clay pots with local materials.
- Pottery making is mostly poorly paid in relation to the hard work it really is. Depending on the chosen business model, the production of clay pots for the clay pot cooler can increase revenues of the potters (mostly women).
- Prevention of diseases stemming from the consumption of spoiled foodstuff.
- Longer storage life of products slows down the fall in prices which can lead to a raise of revenue from fruit and vegetable sellers (mostly women).
- Enhanced temporal flexibility in selling fruits and vegetables can lead to a higher school attendance of vegetable selling girls (this was shown in northern Nigeria).

Figure 4: A group of potters in front of their pottery kiln.

Background

The clay pot cooler was invented in the 1990s by the teacher Mohammed Bah Abba who descends from a pot making family in northern Nigeria. Abba's Organization called Mobah Rural Horizon distributed more than

100,000 clay pot coolers throughout the north of Nigeria until 2010 (Oluwasola/UNDP: 2011). After the millennium several international NGOs started to work on the dissemination of this technology in various African countries (like Practical Action in Sudan and Humanity first in Gambia). The German Association Movement e.V. started to work on the dissemination of the clay pot cooler in 2009. This work was limited to several three month long fieldtrips; due to financial and human resource constraints. Nevertheless, it was possible to gain a decent amount of experience which, combined with information from the internet and personal contacts to other experts to serve as knowledgebase for the following construction and utilization manual.

Production of a clay pot cooler

Manufacturing of clay pots

You need two fired clay pots with different sizes (see fig. 5 and 6) so that the smaller one can be placed into the bigger one[1]. The distance between the two clay pots should be around 4 to 6 cm. Because clay pots with these desired dimensions are often not in the normal range of potters' products, they usually need to be specially made. Getting the right materials on the spot, manufacturing the clay pots and firing them, requires a lot of expertise and local knowledge. Therefore we recommend producing the clay pots in collaboration with experienced potters.

If clay pots are already available in the desired shape and design, this part of the manual can be skipped and you can continue with the part "From clay pots to the clay pot cooler".

01. The clay as major ingredient is intermingled with broken bits of old clay pots and water to a homogeneous and well kneadable matter. Depending from the region some pot makers add straw or dung of donkeys to strengthen the stability of the clay pots.

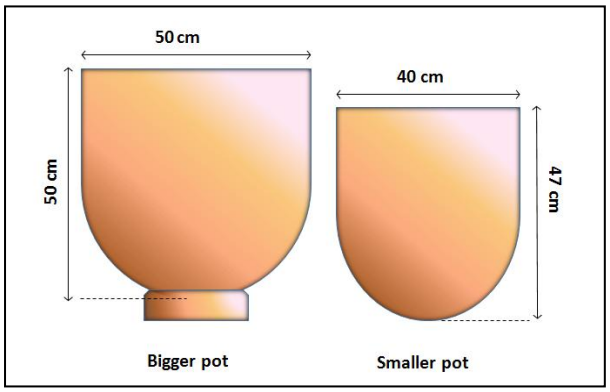

Figure 5: Dimensions of two ideally sized pots for clay pot coolers.

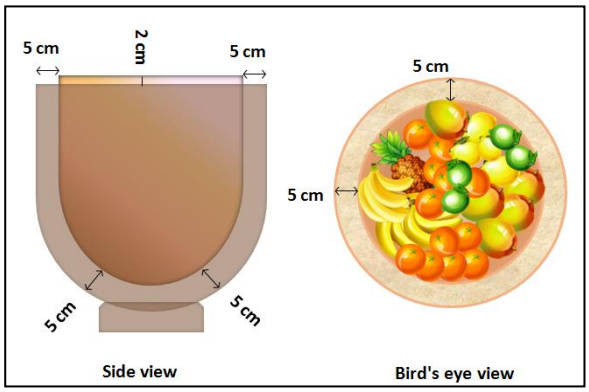

Figure 6: Dimensions of an assembled clay pot cooler.

02. Making the clay pots:
    - The making of clay pots can be simplified by different auxiliary means. Many potters in Burkina Faso use roundly shaped concrete moulds embedded in the ground to beat a clump of clay with a pestle to a spherical pot. However a totally spherical shape is not advantageous for the clay pot cooler, because the opening would be too small for an adequately sized inner poet. Therefore, arriving at the widest diameter, it is better to stop beating the clay and continue building up vertically through adding new bulges of clay.

[1] All stated dimensions in this technical brief are only approximate and optimized according the experience of Movement e.V.. Nevertheless these dimensions are only suggestions and it's not worth the trouble to try to attain them exactly. The most important thing is that you can place the smaller clay pot in the bigger one.

- Alternatively, different sized basins made of plastic or metal can be used. You should pay attention that the basins have the desired dimensions.
- Another option is to create a mould made from a mixture of mud, dung and water. To prevent sticking the mould is covered with a small amount of wood chippings. Contrary to the moulds described before, the clay is placed regularly on the outer side of an upside down mould. The mould should be removed as soon as possible, since the shrinkage of drying clay could cause problems.

03. The clay pots should be completely dried, before they can be burned. The duration of the drying process is dependent on the local weather conditions (~3-7 days).
04. Burning of the clay pots:
    - The process of burning the pots varies from region to region. Because most potters in development countries don't have pottery kilns, the burning of the clay pots is done in big fires, where many clay pots are burnt at the same time.
    - Different types of wood as and dried cow dung serve as burning materials.
    - The fire has to be protected from wind. Therefore the fire is often placed in a natural or artificial pit and additionally protected by sheet metal on top and pieces of broken clay pots on the sides.
    - After setting the fire, the pots remain there for around 24 hours before they can be removed and utilized to build clay pot coolers.

From clay pots to the clay pot cooler

Layer of cement on inner clay pot

The smaller clay pot should be covered with a thin layer of cement on the inner or outer surface to prevent water diffusing through the pores of the smaller clay pot (see fig. 7 and fig. 8). After applying the layer of cement on the pot, the cement should be watered several times in the following 24 hours in order to prevent thin cracks throughout the cement layer.

Figure 5: Women are learning how to apply the cement layer during a workshop.

Sand

The space between the two clay pots is filled with sieved sand. To get an optimal functionality, the sand has to be sieved with two sieves of different mesh sizes. You start sieving with a bigger mesh size to filter out grains and small stones that are too big. Subsequently you take the once-sieved sand and sieve it again with a thin cloth, in order to dispose of dust and tiny clay particles. The remained coarse sand has a high water storage capacity and does not grow hard, when it dries out like sand mixed with clay particles does. Sieving the sand is important to ensure the long term functionality of the clay pot cooler.

Figure 6: Movement e.V. team members with two pots ready to install.

Place of use

Due to the considerable weight of a completed clay pot cooler, it should be assembled directly at the place of use. This place should be shady, to avoid the heat from the sun, and well ventilated to get ideal conditions for the evaporation process.

Installation

01. A layer of sand is filled in the bottom of the large clay pot, for the small pot to sit on (see fig. 9).The thickness of this first layer of sand layer in the base of the bigger pot, should be adjusted such that the upper rim of the small pot is at least 2 cm higher than the big pots' rim. This prevents water from entering in the inner pot while the daily watering of the sand.
02. Subsequently, the space between the two clay pots is filled with sand. During this procedure, ensure that the inner pot stays exactly in the middle of the outer pot so that the distance between the two pots is identical in all directions.
03. The clay pot cooler is completed when the sand fills the space between the pots to about 3 cm below the edge of the outer clay pot to allow space to add water (see fig.11) .

Figure 7: Smaller clay pot is place in the bigger clay pot.

Figure 8: Completed clay pot – ready to use.

Potential upgrades

Our experience has shown that some users wish to have additional features to the basic clay pot cooler described above. All potential upgrades listed below have a certain practical utility; however they cause as well additional costs. Therefore it should be examined if a potential upgrade is worth the additional costs from the customer's point of view.

- **Locking device:** to prevent the unauthorized access.
- **Net to carry the pots:** it is possible to knot a handmade net out of ropes in order to increase the mobility of the clay pot cooler. However the cooler should only be moved in really necessary cases because of its fragility.
- **Modified wheelbarrow:** a wheelbarrow can be modified to transport a clay pot cooler.
- **Automatic drip irrigation:** with a water canister and pinched up hoses a simple drip irrigation can be built to make the multiple and manual daily irrigations superfluous.

Usage hints

Figure 9: Irrigation of the sand between the pots.

Place of use:

The clay pot cooler should be placed at a shady and well ventilated place.

Regular Irrigation:

The sand in between the two clay pots should be irrigated three times a day (morning, noon, evening). The quantity of water is sufficient, when the water does not seep away in the sand within a few seconds, showing that the small interspaces between the grains of sand are filled with water (see fig. 11).

Covering:

The opening on top of the clay pot should be covered with a lid, a plate or a repeatedly folded wet cloth. Like the sand the cloth should also be humidified three times a day.

Hygiene:

Like any device for storing food, the clay pot cooler should be kept clean. Therefore the surface of the inner clay pot should be sponged off regularly.

Figure 10: Movement team member with a test series of four covered clay pot coolers

Further information

There is some information on the clay pot cooler in the internet, but most of it lacks useful details, which we tried to provide with this document. While searching for information about the clay pot cooler it can help to alternate search words because the clay pot cooler is known under several names:

English: clay pot cooler, pot in pot cooler, desert fridge, zeer pot cooler, ceramic refrigerator, clay evaporative cooler;

French: canari frigo, frigo du désert, pot dans le pot frigo;

German: Tonkrügkühler, Topf in Topf Kühlschrank, Wüstenkühlschrank.

Links

For further information on the clay pot cooler you can consult the following links:

- www.movement-verein.org
- http://en.howtopedia.org/wiki/How_to_Make_a_Desert_Fridge
- http://practicalaction.org/evaporative-cooling
- http://practicalaction.org/media/view/10770
- http://practicalaction.org/clay-evaporative-cooler-performance-research
- http://uk.humanityfirst.org/node/42
- http://en.wikipedia.org/wiki/Pot-in-pot_refrigerator
- Video (English), Humanity First, Gambia: http://youtu.be/92fpnUfRt1A
- Video (English), Practical Action, Sudan: http://youtu.be/ZNKifJHqScc
- Video (French): Frigo du désert http://youtu.be/khmJNxFJ_Cw

Source

Oluwasola, O. (2011). *Pot-in-pot Enterprise: Fridge for the Poor*. United Nations Development Programme.

Collaboration and contact

Movement e.V. is willing to share the knowledge about the clay pot cooler as well to cooperate with other actors in Burkina Faso or other countries in order to support the dissemination of the clay pot cooler. Movement is also offering special trainings in construction and use of the clay pot cooler.

The information provided in this technical brief comes mainly from the clay pot cooler project of Movement e.V. in northern Burkina Faso. For more details, suggestions or ideas for improvements or possible collaborations contact us via email.

Please let us know when you are starting some kind of clay pot cooler project. This allows us to get an idea about the impact of our efforts for know-how transfer.

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Movement e.v. is a German Association which works in Burkina Faso in close collaboration with local people notably in the field of appropriate technologies.